ANNUAL PROGRESS REPORT

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TITLE OF PROJECT: The Effects of Ingestion of Large Doses of Radioactive Elements on the Alimentary Canal (Including Mouth, Teeth and Periodontal Structures and Other Vital Organs)

Objectives: Although much experimental work has been done with external and parenteral dosesof radiation, very little is known about the effect of oral ingestion of radioactive materials. In the above metabolic studies the radioactive elements were given by stomach tube thereby by-passing the oral cavity. Since many low-energy radiations are inneffective when applied externally, but highly damaging when injected peritoneally, it is felt that a study of low-energy as well as high-energy radiations administered orally might prove of great value for early diagnosis of pathologic lesions produced by radioactive elements.

ABSTRACT (OR SUMMARY) OF RESULTS

a. Since start of project:

(1) The most efficient method of handling Zr and Nb^{95} is as complexed oxalate solutions. Efforts to prevent plating out of the uncomplexed carrier-free isotopes were unsuccessful either in plastic (polyethylene) or ceresin wax coated containers.

(2) A single ingested dose is not passed along the gastro-intestinal tract as a unit. Feces collection and radio-analysis revealed that anywhere from 2 to 7 days may be required for complete excretion of radioisotope ingested in a 4 hour period.

(3) An average of 98.25% of the offered dose of Zr and Nb^{95} was consumed and of this amount about 93% was recovered in the feces.

(4) In the rat the cecum is an organ of putrefaction and storage of intestinal contents. This makes this organ the chief target of radiation passing through the alimentary canal. The accompanying graph indicatesthe distribution of the Zr and Nb^{95} during successive 6 hour intervals of the first day following ingestion. The storage function of the cecum (included in Large Intestine Data) is revealed in the 12-24 hour sampling of the animals. At 12 hours the stomach and small and large intestines have almost equal amounts of isotope while at 18 hours the stomach and small intestine have declined considerably in isotope content. The large intestine has increased to a maximum of such magnitude that one must infer that it has acquired the ingested isotope from the initial portions of the G.I. tract while retaining most of the amount it contained at 12 hours.

It is obvious from this that the cecum and large intestine should be the most severely irradiated structures included in this study. Furthermore the mouth and esophagus are the least irradiated organs since passage through them is so rapid.

(5) During the month immediately following ingestion of the Zr-Nb^{95} mixture, nitrogen balance is less positive for the irradiated animals than for their controls.

(6) The thymico-lymphatic apparatus undergoes what appears to be a reduction in size during the initial 3 days following administration of the dose. The adrenal glands tend to enlarge in the irradiated animals but this is by no means a constant finding.

b. During current report period:

(1) Histologically the irradiated animals exhibited appreciably less basophilic matter (hematoxylin stained) at the germinative layers of the stomach. This suggestion of less nuclear material was evident in the cells lining the gastric glands. Intestinal tissue has not yet been subject to analysis.

(2) Food consumption has been followed daily for 28 days, the results expressed as grams of food consumed per 100 gms. of body weight is presented in Table I. No noteworthy trend is apparent in the data, the average amount of food being about the same for the 28 days.

(3) Feces weight, water content and ash content have been analyzed for a 1 month period following ingestion of Zr and Nb^{95}. These data appear in Table II.

(4) Thymic, splenic and adrenal wet weights have been obtained over a one month period following irradiation. These appear in Table III.

Conclusions:

No significant variations have been observed in the gross composition of feces during the month immediately following ingestion of fission products of unabsorbable nature. Variations observed to date may be explained as due to either the normal biological fluctuations or to the deprivation of food and ordinary water preceding the ingestion period.

Of the three visceral organs studied, only the spleen appeared to show a definite trend in dimensional change. Its smallest weight occurred three days following the ingestion of the fission products.

No significant variations in food intake were observed during the experimental period.

PLANS FOR FUTURE:

Immediate: Enlargement of data on analysis of feces, food consumption and organ weights. Feulgen staining will be used to clarify the apparent deficiency of nuclear material in gastric (and possibly intestinal) epithelia.

Long Range: Use of physiological factors to alter the rate of passage of the ingested isotopes. These include, fatty diets, sticky consistency of diet, partial starvation.

TABLE I

Grams of Food Eaten Daily per 100 gms. of Body Weight
Values represent average of 4 animals

Days	Gms. eaten	Days	Gms. eaten	Days	Gms. eaten	Days	Gms. eaten
1	8.61	8	8.02	15	8.29	22	9.79
2	6.90	9	8.73	16	8.89	23	11.4
3	8.05	10	7.67	17	8.43	24	10.7
4	7.54	11	6.72	18	8.43	25	9.79
5	8.95	12	8.36	19	8.87	26	11.4
6	8.62	13	9.01	20	8.87	27	11.4
7	7.55	14	8.87	21	8.87	28	11.4

TABLE II

Wet Weight of Water and Ash Content of Feces of 200 gram Rats
Following a Single Ingestion of 6 mc. of $ZrNb^{95}$ in Drinking Water

Days Post Ingestion	Wet Weight of Feces per Kgm. Body Wt.	% Water in Feces	% Ash in Feces
2	25.9	33.4	5.97
4	50.0	69.8	8.59
7	28.1	21.8	9.83
8	28.0	25.0	9.39
14	25.3	26.4	9.28
15	26.8	22.6	9.76
16	27.6	38.1	6.54
17	35.4	43.2	7.68
21	17.6	17.5	9.27
22	24.1	15.3	9.65
23	31.8	24.2	7.69
24	33.5	35.7	8.50
25	22.8	24.2	10.2

TABLE III

Percent of Organ Weight per gram Body Weight

Days	Thymus	Spleen	Adrenals
3	.149	.147	.0150
7	.108	.219	.0111
14	.184	.233	.0131
21	.113	.176	.0129
28	.101	.258	.0141

GRAPH I

Percent of Zr and Nb^{95} in Portions of Alimentary Canal During First 24 hours after Ingestion